RESULTS OF A STATISTICAL STUDY OF VARIATION IN THE BLUE SHELLS OF PECTEN NUCLEUS IRRADIANS FOUND AT ATLANTIC CITY, N. J.

BY HAROLD S. COLTON.

Upon the beach of the Atlantic shore of New Jersey are found dead shells colored blue by clay particles infiltered into the shell. These shells have obviously been buried in the mud or clay of the bottom, out of which they have been washed by the surf.

In collecting shells from along the beach at Atlantic City in 1904, the author fancied that the blue *Lunatia heros* differed in shape from the uncolored ones.

Not having sufficient material with which to base a conclusion, he returned in the Spring to Atlantic City to collect *Lunatia*. Although in January they were abundant, now not a single one could be found. At once it was seen that *Pecten* would be a much more favorable form on which to work, as it was abundant and the ribs of the shell would be easy to count, therefore a few hundred of white and blue ones were collected.

In the course of time the writer happened to mention to Dr. E. F. Phillips, the present chief of the Bureau of Apiculture at Washington, on what material he was working. Dr. Phillips became interested, and in 1905 a joint trip to the coast was made and over five hundred blue right valves of Pecten were collected near Ventnor.

The ribs of these were counted, applying the arbitrary rules of Davenport (1900). The number of ribs of each shell was counted independently and compared. When there was a difference of opinion the ribs were recounted, and no record was made until both agreed.

This study was not completed and therefore not published. While sufficient blue ones were at hand, not enough white ones (representing the form of Pecten now living) were collected for comparison. However, in looking over the results it seemed that it might be of interest to publish them as they

stand and let some one else take up the problem and bring it to a conclusion.

In some places along the Atlantic coast of New Jersey are exposed at low tide stumps of trees and also such turf as is now forming in the meadows behind the line of sand dunes. By this we can infer that the coast line is sinking. This being the case, the dunes are progressing inland, covering up the meadow turf and exposing it again in the ocean beach. Between the dunes and the mainland is oftentimes a bay or a channel. This bay or channel has a muddy bottom as a rule and there the Pecten lives. As the dune line progresses forward the meadow encroaches on the bay, burying the dead shells of the Pecten which are later exposed by the action of the surf and cast on the beach after the dune line has passed over them.

It would be interesting to test if such a theory were correct and note the direction of the evolution of the Pecten or other form during the time that they were buried.

An examination of well borings made in the beach might help throw light upon this point.

Experiments also might be made as to the rate of infiltration of the clay particles into the shell which may be rapid. The author made sections of the shells. These sections show that the clay has penetrated the shell to the center, the pearly layer alone excepted.

With the geologic evidence from well borings, with the experimental evidence from the rate of infiltration of the clay particles and the comparison of the variation of the blue forms with those now living, a conclusion might be drawn as to the direction of evolution in Pecten.

In the table which follows, N = the number of shells the rays of which were counted,—A = the mean,—σ the standard deviation from the mean,—C = the coefficient of variation,—and P. E. the probable errors of the mean, the standard deviation, and the coefficient of variation. These have been computed by the ordinary methods. With them in lower case are placed similar counts made by Davenport (1900) on *Pecten irradians* from several other localities.

Pecten irradians	Ray Frequency 14	15	16	17	18	19	20	21	N	A	P.E.A.	σ	P.E. σ.	C	P.E.C.
Blue Pecten Atlantic City	6	72	187	185	44	5	1	.	500	16.416	$\pm$ .028	.028	$\pm$ .020	5.65	$\pm$ .12
Cold Spring Harbor . .	2	15	108	515	308	90	7	1	1046	17.35	$\pm$ .018	.876	$\pm$ .013	5.049	$\pm$ .074
Cutchogue . .	.	33	95	127	22	4	.	.	281	16.53	$\pm$ .034	.852	$\pm$ .024	5.15	$\pm$ .15
Fire and Oak Islands . .	1	6	15	24	4	.	.	.	50	16.48	$\pm$ .084	.877	$\pm$ .060		

These comparisons show that the average number of ribs of the blue Pecten at Atlantic City is less than the same species at Cold Spring Harbor but about the same as at Fire Island and Cutchogne. That they are more variable than any of these that Davenport reported is also shown by the statistics. To determine the significance of these differences will require much more work.

The author wishes to thank Dr. E. F. Phillips for his share in the work, and also for first introducing him to modern statistical methods.

Literature.

Davenport, C. B.—1900. On the Variation of the shell of Pecten irradians Lamarck, from Long Island. Am. Nat. XXXIV, pp. 863-877.

Davenport, C. B.—1903. A Comparison of the Variability of some Pectens from the East and the West Coast of the United States. Mark Anniversary Volume, pp. 121-136, New York, Henry Holt.

Davenport, C. B.—1903. Quantitative Studies in the Evodution of Pecten opercularis from three localities of the British Isles. Proc. Am. Acad. Arts and Science XXXIX, pp. 123-159.

Davenport and Hubbard, M. E.—1904. Ray Variability in Pecten varius. Jour. Exp. Zool., Vol. 1, p. 607.

Davenport, C. B.—1904. Statistical Methods. Wiley & Sons, New York.